Utility Patent Application

CONFIDENTIAL INFORMATION

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STRIP MATERIAL APPLICATOR APPARATUS

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Serial No. 60/432,105 filed on 12/10/2002, the disclosure of which is hereby incorporated by reference as if fully rewritten.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a device for applying a strip of material to an object and, more particularly, to a device for applying a strip of adhesive tape or reflective sheeting to an object that is rotated on a mandrel and in communication with at least one tape or sheeting head.

2. Description of the Related Art

A number of devices have been constructed for applying bands of metal, tape, adhesive or other similar materials to polygonal bodies. At least three general embodiments representative of such devices are found in U.S. Patent Nos. **3,899,383** and **4,009,072** (issued in the name of *Schultz et al.*) and U.S. Patent No. **2,575,887** (issued in the name of *Nitchie*).

In the patents issued to *Schultz et al.*, a device for applying spaced lengths of reflex-reflective strip material to a tire casing is disclosed. The device comprises an applying station defined by two strip applying heads axially aligned on the same side of the tire casing, thereby applying the material in a parallel alignment about the tire casing.

In the patent issued to *Nitchie*, a box blank taping machine is disclosed, in which tape is applied to the boxes along the edges so as to form a box. The taping machine comprises a tape reel arranged in a free loop configuration.

The aforementioned patents suffer from several deficiencies, the most prominent of which are noted. Included is the failure to provide a cutting mechanism that provides optimal tautness to the material for severing and forming a substantially seamless connection between the head and tails of the material. Yet another deficiency includes the failure to provide means for cleaning the cutting mechanism after consecutive cuts, thereby eliminating adhesive build-up on the cutting mechanism. Another deficiency includes the failure to provide means for

automatically detecting exhaustion of the reel or spool upon which the material is wound. Another deficiency includes the failure to provide means for removing oil and/or liquid residue that remains from production of a plastic body

Consequently, a need for a device which overcomes the inefficiencies and deficiencies noted above is evident, and is fulfilled by the present invention.

A search of the prior art did not disclose any patents that read directly on the claims of the instant invention; however, the following references were also considered related:

U.S. Patent No. **4,083,033**, issued in the name of *Kulp et al.*, discloses a traffic control device in the form of a drum or barrel;

U.S. Patent No. **5,753,347**, issued in the name of *Baker et al.*, discloses a traffic control device having double walled construction; and

U.S. Patent No. **6,017,602**, issued in the name of *Baker et al.*, discloses a traffic control device having double walled construction.

In one embodiment of the present invention disclosed herein, the present invention is described as a device for applying reflective tape or sheeting to a traffic control device, such as a drum or barrel. The manufacture and functional appearance of the drums/barrels are governed by a manual produced by the Federal Highway Administration (FHWA), and is entitled "Manual of Uniform Traffic Control Devices" (MUTCD), and is accessible at http://www.mutcd.fhwa.dot.gov. In Part 6, § 6F.59, the MUTCD requires that horizontally circumferential bands of reflective striping are adhered to the drum or barrel in alternating orange and white

stripes. The reflective stripes are required to have a dimensional width of four inches or six inches. As such, the embodiment corresponding to application of reflective sheeting to a traffic control drum or barrel is particularly advantageous in fulfilling the requirements of the MUTCD.

SUMMARY OF THE INVENTION

Briefly described according to one embodiment of the present invention, an apparatus for applying strip material to an object comprises a base having a mandrel for supporting an object, the mandrel projecting from the base, a plurality of clamps selectively movable for engaging and maintaining the position of the object, the plurality of clamps affixed to the base, and at least one strip material applicator assembly selectively movable for engaging and applying strip material onto the object as the base rotates. The base rotates via a motor integrally coupled thereto.

It is a feature of the present invention to provide an apparatus having a base comprising a plurality of openings formed in the area on which the mandrel rests. The openings operate in conjunction with a plurality of openings formed in the mandrel(at the opposite end) so as to prevent creation of vacuum pressure and lock on the object when placed on the mandrel.

It is another feature of the present invention to provide an apparatus having a mandrel outwardly projecting from and substantially perpendicular to the base. The mandrel is envisioned as having a variety of lengths and diameters to provide versatility in accommodating variously dimensioned objects.

It is envisioned that the mandrel is dimensioned so as to compliment the internal area of an object, such as a drum, a barrel, a stepped cone or other similar devices of varying lengths and widths. However, it should be noted that the object can have only a slight draft angle for moldability, because if the draft angle is too great on the object, the strip material will not track properly and wrinkles and air pockets will form. It is further envisioned that the mandrel is tapered from a fixed end to a free end (widest width at fixed end and narrowest width at free end). The tapering may be configured to have a uniformly gradual taper, such as similar to a cone. The tapering may also be configured to have a stepped taper, wherein at specified lengths of the mandrel, the exterior circumference is offset toward a center or central axis of the base and mandrel, so that a series of steps are formed (from a widest width at fixed end to a narrow width at free end). It is further envisioned that the mandrel comprises a plurality of openings formed at the free end substantially perpendicular to the central axis. As indicated previously, the openings operate cooperatively with openings to prevent formation of vacuum pressure on object during application of strip material.

It is another feature of the present invention to provide an apparatus having a plurality of clamps affixed to the base, the clamps provided to selective move between an engaged and disengaged (resting) position. When actuated, the clamps engage and impinge against the object seated on the mandrel. The clamps are controlled by an air cylinder.

It is another feature of the present invention to provide an apparatus having at least one strip material applicator assembly, wherein each assembly comprises a panel upon which a pair of spools, at least one roller guide, a pair of vacuum blocks, an arm and guide wheels are affixed. The panel is urged forward and backward along a track via a limited pressure air cylinder. The pair of spools dispense or release the strip material. The at least one roller guide is provided for aligning the strip material onto the object. The pair of vacuum blocks cooperatively operate to begin and end application of the strip material. The arm includes a scalpel affixed at a free end thereof, the arm severing the strip material. The guide wheels engage the object for maintaining proper spatial relationship between the assembly and the object.

It is another feature of the present invention to provide an apparatus further comprising a direct plasma flame treatment member, wherein the direct plasma flame treatment member generates a flame for evaporating liquid residue left from fabrication of the object. Furthermore, the direct plasma flame treatment of the object warms the object to activate any adhesive provided on the strip material, thereby optimizing the adhesion between the strip material and the object.

It is another feature of the present invention to provide an apparatus further comprising a brush head, wherein the brush head is used to firmly press the applied strip material against the object, thereby removing any air pockets that may have formed during application, and further optimizing adhesion between the strip material and the object.

It is another feature of the present invention to provide an apparatus further comprising a visual detector / curtain, in conjunction with full perimeter guarding where access is not required, wherein a pair of detectors are affixed at a front of the apparatus, wherein unauthorized penetration of an item (such as an operator's arm, leg, a tool or other flying debris) breaks a beam between the detectors and automatically terminates the application cycle. This automatic termination prevents injury to an operator, damage to tools, damage to the apparatus, and ensures the safe operation of the apparatus, in general.

BRIEF DESCRIPTION OF THE DRAWINGS

The advantages and features of the present invention will become better understood with reference to the following more detailed description and claims taken in conjunction with the accompanying drawings, in which like elements are identified with like symbols, and in which:

FIG. 1 is a perspective view of an apparatus for applying strip material to an object depicted as supported and enclosed by a frame;

FIG. 2 is an exploded perspective view of a motor, base, mandrel and object of the apparatus of **FIG. 1**;

FIG. 3a is perspective view of an applicator assembly engaging an object;

FIG. 3b is an enlarged perspective view of **FIG. 3a**, wherein an upper vacuum block and wheels are removed to clearly illustrate the arm, the scalpel at the end of the arm, and the slot in which the scalpel resides, the slot having felt wicks saturated with solvent for cleaning the scalpel after use;

FIG. 4a is perspective view of the front of a vacuum block;

FIG. 4b is a perspective view of the rear of the vacuum block;

FIG. 4c is a top view of the front of the vacuum block;

FIG. 5 is a perspective view of a flame member that is raised and lowered, and when lowered (shown in phantom lines) engages an object to evaporate any liquid and/or residue that might remain; and

FIG. 6 is a perspective view of a brush head that is raised and lowered (shown in phantom), and when raised engages an object to firmly press against the applied strip material, thereby removing any air pockets and aiding in adhesion between the strip material and the surface of the object.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The best mode for carrying out the invention is presented in terms of its preferred embodiment, herein depicted within Figures 1 through 6.

1. Detailed Description of the Figures

Referring to **FIG. 1**, an apparatus for applying strip material to an object **10** (hereinafter "apparatus") is shown in accordance with a preferred embodiment of the present invention. The apparatus **10** comprises a base **12** having a mandrel **14** for supporting the object "**O**", the mandrel **14** projecting from the base **12**, a plurality of clamps **16** selectively movable for engaging and maintaining the position of the object "**O**", the plurality of clamps **16** affixed to the base **12**, and at least one strip

material applicator assembly **18** selectively movable for engaging and applying strip material "**S**" onto the object "**O**" as the base **12** rotates. The base **12** rotates via a motor **20** integrally coupled thereto.

Referring now to **FIG. 2**, the motor **20** is a standard motor package commonly known in the art, and includes a rotary union **22** and an encoder **24** coupled therein, the encoder **24** providing precise control of direct flame plasma treatment, strip material application and brushing sequence further described below. A worm gear reducer and DC motor rotates the mandrel **14**, although other variations of the components integral to the motor **20** are envisioned, including common substitutions known to one of ordinary skill in the art.

The base **12** is substantially planar and may have a variety of geometric configurations, including a circular or disc form, square, rectangular or other polygonal form. So long as the base **12** is of sufficient size to accommodate the mandrel **14** and the clamps **16**, and does not interfere with rotation of the base **12**, the size and form are variable. The base **12** is envisioned as comprising a plurality of openings **26** formed in the area on which the mandrel **14** rests. The openings **26** operate in conjunction with a plurality of openings **28** formed in the mandrel **14** (at the opposite end) so as to prevent creation of vacuum pressure and lock on the object "**O**" when placed on the mandrel **14**.

The mandrel **14** outwardly projects from and is substantially perpendicular to the base **12**. The mandrel **14** may be fabricated from a variety of materials,

including metal or plastic, so long as the material is durable and rigid to fully withstand and support repeated placement and removal of an object "**O**" thereon. The mandrel **14** is envisioned as having a variety of lengths and diameters to provide versatility in accommodating variously dimensioned objects "**O**". It is envisioned that the mandrel **14** is dimensioned so as to compliment the internal area of an object "**O**", such as a drum, a barrel, a stepped cone or other similar devices of varying lengths and widths (and is further detailed below). However, it should be noted that the object "**O**" can have only a slight draft angle for moldability, because if the draft angle is too great on the object, the strip material will not track properly and wrinkles and air pockets will form. It is further envisioned that the mandrel **14** is tapered from a fixed end **14a** to a free end **14b** (widest width at fixed end **14a** and narrowest width at free end **14b**). The tapering may be configured to have a uniformly gradual taper, such as similar to a cone. The tapering may also be configured to have a stepped taper, wherein at specified lengths of the mandrel **14**, the exterior circumference is offset toward a center or central axis "**C**" of the base **12** and mandrel **14**, so that a series of steps are formed (from a widest width at fixed end **14a** to a narrow width at free end **14b**). It is further envisioned that the mandrel **14** comprises a plurality of openings **28** formed at the free end **14b** substantially perpendicular to the central axis "**C**". As indicated previously, the openings **28** operate cooperatively with openings **26** to prevent formation of vacuum pressure on object "**O**" during application of strip material "**S**".

The plurality of clamps **16** are affixed to the base **12** and comprise a leg **30** and a foot **32**, although other configurations are envisioned as permissible substitutions thereof and functioning in a similar manner, the leg **30** and foot **32** coupled to an air cylinder **34** for providing engagement and disengagement of object "**O**". When the clamps **16** and air cylinder **34** are actuated for operation, the air cylinder **34** urges the clamps **16** into engagement with the object "**O**", wherein the foot **32** directly contacts and engages a portion of the exterior of the object "**O**". The foot **32** may comprise a linear or curvilinear configuration, provided that the foot **32** (and the clamp **16** collectively) functions properly in securely impinging the object "**O**" in place during application of strip material "**S**". It is envisioned that at least two clamps **16** are required for securing the object "**O**", and in such a configuration, the clamps **16** are positioned approximately 180° apart. It is further envisioned that four clamps **16** are capable of supplying greater security and impingement upon the object "**O**", and in such a configuration, the clamps **16** are positioned approximately 90° apart. A locking block **33** engages a detail on the object "**O**" so that the object "**O**" remains fixed relative to an installed position, thereby preventing object "**O**" from spinning on the mandrel **14**, since application of strip material "**S**" generates considerable drag on the object "**O**" because of tension adjustment necessary to maintain tautness to the strip material "**S**", which can cause the object "**O**" to shift. After the object "**O**", base **12** and mandrel **14**, collectively, complete the application

cycle (as described below), the air cylinder **34** releases the pressure that urged the clamps **16** onto the object "**O**", thereby permitting retraction of the clamps **16** from the object "**O**" into a starting or home position and ready for a subsequent application cycle.

Referring now to **FIG. 3a** and **FIG. 3b**, the strip material applicator assembly **18** is a unit comprising a panel **36** upon which a pair of spools **38** and **40**, at least one roller guide **42**, a pair of vacuum blocks **44** and **46**, an arm **48** and guide wheels **52** are affixed. The panel **36** is urged forward and backward along a track **54** via a limited pressure air cylinder **56** (wherein the track **54** may have a single, double or triple rail configuration, a double rail version is depicted in the figures). The panel **36** comprises a slot **58** having felt wicks **60** saturated with cleaning solvent placed therein, the slot **58** receiving the arm **48** and cleansing a scalpel **50** (further described below) so as to remove accumulated debris and prepare the arm **48** and scalpel **50** for subsequent use. The pair of spools **38** and **40** releases the strip material "**S**" for application to the object "**O**". The pair of spools **38** and **40** comprises a strip material spool and a backing material spool, and for purposes of illustration only of the figures depicted, the strip material spool is designated **38** and the backing material spool is designated **40**. The strip material spool **38** comprises a removable and replaceable roll of strip material "**S**" for dispensing. The strip material spool **38** comprises or works in conjunction with a photo-detector **60** that automatically terminates application of the strip material "**S**" upon failure to detect

the strip material "**S**" on the strip material spool **38**. The automatic termination of the application sequence or cycle permits an operator to quickly and efficiently remove the exhausted strip material paper core from strip material spool **38** and replace with a quantity of strip material "**S**" for further application. The backing material spool **40** collects the backing material "**S**" separated from the strip material "**S**" during application onto the object "**O**". The backing material spool **40** is driven by an air motor **62** positioned behind the backing material spool **40**, the air motor **62** allowing for adjustment to pulling tension and speed of collecting the backing material "**S**".

Each of one of the pair of spools **38** and **40** comprise a laterally adjustable flange **64** to accommodate strip material "**S**" of varying widths. The adjustable flange **64** operates in conjunction with a locking disc, a pin removably insertable into the disc for lateral adjustment to the spool (with corresponding holes to accommodate lateral adjustment), and an axle coaxial to the mount on which a paper core of strip material "**S**" resides against. The axle has a flat surface upon which a biased O-ring secures a lock rod against. The lock rod prevents the paper core from slipping on the axle and not maintaining the proper drag required keeping the tape tight, thereby distorting the precision of applying the strip material "**S**". A wing nut knob coupled to a biased internal spring and friction disc is distal to the axle and locking disc, thereby permitting tension adjustment on the spool. First, the flange is removed, and then the locking pin is moved to the center of the flat surface

on the axle to release any hold it has on the core, thereby allowing it to be removed and new strip material "**S**" installed.

At least one roller guide **42** for aligning the strip material "**S**" onto the object "**O**" is provided. It is envisioned that a plurality of roller guides (denoted as **42a**, **42b** and **42c**, respectively) are included to provide optimal alignment and precision in applying strip material "**S**" to object "**O**". Each one of the roller guides **42a**, **42b** and **42c** comprise a collar **66** affixed to the panel **36** with a linearly elongated shaft **68** projecting therefrom, the strip material "**S**" following the path of the shaft **68**. A second collar **70** is affixed at an opposite end of the shaft **68**, the collars **66** and **70** cooperatively functioning to guide the strip material "**S**" therein and preventing the strip material "**S**" from deviating from that desired path or course. It is envisioned that the collar **70** is secured to the shaft **68** via a wing nut or knob so that the collar **70** may be removed and either replaced with a more narrow or wider collar **70** so that accommodation for various widths of strip material "**S**" is provided. It is also envisioned that the collar **70**, after removal, may be reversed so that the former distal portion of the collar **70** is more proximally placed, thereby reducing the width of the path along shaft **68**, thus accommodating narrow widths of strip material "**S**". The width of the path of shaft **68** is envisioned as adjustable between one-half (0.5) and six (6) inches, the standard width dimensions of most strip material "**S**" available. The adjustment of the roller guides **42** corresponds to the need or desire to manage and set the desired placement of strip material "**S**" at one segment of the

object "**O**" (such as the stepped drum or barrel depicted in **FIG. 2**), wherein the placement of strip material "**S**" may be offset from either edge a specified distance, or may be aligned so that a center axis of the strip material "**S**" aligns with the center axis of a segment of the object "**O**", for example.

Referring specifically to **FIG. 3a**, **FIG. 3b**, and **FIG. 4a** through **FIG. 4c**, the pair of vacuum blocks **44** and **46** cooperatively operates to begin and end application of the strip material "**S**". The pair of vacuum blocks may be further defined as an upper vacuum block **44** and a lower vacuum block **46**, wherein a margin **72** separates the upper vacuum block **44** from the lower vacuum block **46**. Each of said pair of vacuum blocks **44** and **46** has a plurality of apertures **74** in communication with a vacuum generator and an air cylinder **76** to accurately position the strip material "**S**" onto the object "**O**". The apertures **74** provided are envisioned as having a diameter sufficiently small to promote vacuum suction on the strip material "**S**" during the application cycle, and to prevent impartation of circular indentations onto the strip material "**S**". By providing small diameter apertures **74**, the force exerted onto the strip material "**S**" by the vacuum and aperture **74** combination is dispersed about the surface area of the strip material "**S**", thereby reducing the probability of indentations imparted thereon. On each vacuum block **44** and **46**, the apertures **74** are segregated into zones "**S**" and coupled to a circuit for activating or deactivating particular zones "**Z**" according to the width of the strip material "**S**". For instance, the vacuum blocks **44** and **46** are envisioned as having

a width slightly greater than six (6) inches, wherein the apertures **74** are arrayed within a six (6) inch width boundary. Because of the zones "**Z**", one zone "**Z**" may be deactivated (such as a distal zone) to accommodate a lesser width of strip material "**S**", thereby preventing non restricted vacuum air flow in the location where the narrower material does not cover, preventing suction or vacuum from building due to the leakage, and otherwise allowing the material to fall freely from the blocks. Three segregated zones are depicted Z_1, Z_2 and Z_3, respectively. The upper vacuum block **46** secures the concluding end of the strip material "**S**" dispensed for application onto the object "**O**" maintaining the end so that arm **48** and scalpel **50** may swing through margin **72** and sever the strip material "**S**". The upper vacuum block **44** pivots or is urged toward the object "**O**" to apply the end of the strip material "**S**" secured by the block **44**. The block **44** follows the form of the object "**O**", by pivoting, in applying the remaining strip material "**S**" to the object "**O**". At this point in the cycle, the vacuum to the upper vacuum block **44** is terminated so as to prevent open-air flow and loss of vacuum pressure to the lower vacuum block **46**. It will not be turned on again until the next quantity of strip material "**S**" has been applied and is in place to cover the apertures **74**. The lower vacuum block **46** secures a new beginning end of the strip material "**S**" after severing of the strip material "**S**" by the arm **48** and scalpel **50**. The block **46** is urged toward the next object "**O**" to apply the beginning end of strip material "**S**" to object "**O**" secured by block **46**. The block **46** follows the form of the object "**O**" in applying the remaining

strip material "**S**" to the object "**O**". A pivotal retention brace **76** is affixed to the lower vacuum block **46** for placing tension on the strip material "**S**", thereby preventing the strip material "**S**" from slipping off of the lower vacuum block **46** during the application process when the strip material "**S**" is being urged forward to the product prior to being applied.

The arm **48** includes a scalpel **50** affixed at a free end thereof, the arm **48** severing the strip material "**S**" by swinging through the margin **72** separating blocks **44** and **46**. The arm **48** rotates by expansion and contraction of an air cylinder **78** communicating with the arm **48**. The arm **48** is biased to nest or return to the slot **58** for cleansing of the scalpel **50** (biasing may be accomplished by spring bias attachment or mechanical setting of pivot pin, bolt, etc.). The arm **48** comprises an elongated member having a bent elbow, wherein a fixed end of the arm **48** is attached to a support **78** by a pivot pin, bolt, screw and nut, or other similar mechanism. A fence **80** is provided either superior to or inferior to the arm **48** (depending upon the configuration of the assembly **18**), the fence **80** functioning as a guide to the arm **48** and preventing upward or downward tilt of the arm **48** due to gravitational forces or mechanical imperfections in the attachment of arm **48** to support **78**.

The guide wheels **52** engage the object "**O**" for maintaining proper spatial relationship between the assembly **18** and object "**O**". The guide wheels **52** are

arranged superior to the blocks **44** and **46**, and rotate about the object "**O**" while the object "**O**" rotates during operation.

It is envisioned that a plurality of assemblies **18** may be provided, including a combination of two assemblies **18** together positioned to one side of a central axis "**C**" of the base **12** and/or mandrel **14**. Another envisioned combination includes a pair of assemblies **18** to one side of the central axis "**C**" and a second pair of assemblies **18** on the opposite side of the central axis "**C**". In the latter configuration (two pairs of assemblies **18** on opposing sides), one pair of assemblies **18** will be configured in reverse of the opposing assemblies **18** because the rotation of the base **12**, mandrel **14** and object "**O**" is fixed, and optimum time efficiency is achieved by all four assemblies **18** applying strip material "**S**" concurrently. Therefore, one pair of assemblies **18** will be reversed and apply strip material "**S**" simultaneously and opposite to the opposing pair of assemblies **18**. However, it is envisioned that application of strip material "**S**" may be alternated from one side to the other, wherein one side of assemblies **18** applies strip material "**S**", and then the rotation of object "**O**" is reverse and the other side of assemblies **18** applies strip material "**S**". Such a configuration would avert the need to reverse the assemblies **18** on one side, but may increase the time required for application of strip material "**S**". Also, if the spacing between the strip material "**S**" is great enough, the need to alternate sides is no longer required. The assembly **18** is

intended to apply a quantity of strip material "**S**" sufficient to circumscribe the circumference of the object "**O**", thereby applying quantity equal to one revolution about the object "**O**".

In accordance with the figures provided, the assembly **18** of **FIG. 3a** and **FIG. 3b** depicts an arrangement wherein a forward portion **36a** of panel **36** is proximal to the plane in which the mandrel **14** and object "**O**" rotate. The slot **58** is formed in the forward portion **36a** thereof. The spools **38** and **40** are affixed at a rearward portion **36b**, wherein the spools **38** and **40** are substantially aligned along a vertical plane. The roller guides **42a**, **42b** and **42c** are arranged near a lower portion **36c** of panel **36**, wherein **42a** is positioned adjacent the rearward portion **36b**, **42c** is position adjacent the forward portion **36a**, and **42b** is positioned therebetween. In relation, the profiles of **42a** and **42b** are higher in profile than **42c**, as **42c** approaches the blocks **44** and **46** and retention brace **76**. The blocks **44** and **46** are positioned higher in profile than **42c** and at the forward portion **36a**. The block **44** is superior to block **46**, with a margin **72** therebetween to accommodate the arm **48** and scalpel **50**. The arm **48** is affixed to support **78** toward the rearward portion **36b**, with the fence **80** positioned near the forward point of arm **48**. This description of the assembly **18** depicted is an aid for understanding the spatial relationship of the components comprising the assembly **18**, but should not be viewed as a limitation of the scope and spirit of the invention.

Referring now to **FIG. 5**, the apparatus **10** may further comprise a direct plasma flame treatment member **82**. The direct plasma flame treatment member **82** is positioned above the base **12** and mandrel **14** and is selectively movable adjacent the object "**O**". The direct plasma flame treatment member **82** generates a flame **84** for evaporating residue from an exterior of the object "**O**", such as oil and/or water residue remaining from the fabrication of the object "**O**". Furthermore, the flaming of the object "**O**" heats up the surface and aids in activation of the glue and/or adhesive on the strip material "**S**", thereby providing optimal adhesion between the strip material "**S**" and the object "**O**". The direct plasma flame treatment member **82** produces a gaseous hydrocarbon fuel that reacts with the surface of the substrate (such as polymers, aluminum or glass, for example) of object "**O**", while avoiding the production of ozone and other harmful by-products and also avoiding the use of high voltage. It should be noted that flaming after application will damage the quality of the strip material beyond the point of usefulness. The direct plasma flame treatment member **82** comprises a pipe **86** operatively coupled with an air and gas mixture, the air and gas mixture provided to allow for adjustment in the intensity of the flame **84** as desired or required. The pipe **86** is coupled with a pivotal flame member arm **88** that raises and lowers the direct plasma flame treatment member **82** (and more particularly pipe **86**) into the proper engaged or disengaged positions. It is envisioned that the pipe **86** length may be reduced to focus the flaming onto the surface area to which the strip

material "**S**" is specifically applied to object "**O**". When actuated during the operation sequence, the pivotal flame member arm **88** moves from a raised (and disengaged) position to a lower (and engaged) position, the pipe **86** adjacent to the exterior circumference or perimeter of object "**O**". The flame **84** is actuated to engage the exterior circumference or surface of object "**O**" for approximately one revolution of object "**O**". Thereafter, the sequence deactivates the direct plasma flame treatment member **82**, wherein the flame arm member **88** retracts and returns to the home or starting position away from the object "**O**", thereby retracting the flame **84** within pipe **86**. The pipe **86** is configured so that a channel **90** is formed facing the object "**O**" along the entire length thereof, thus providing coverage for the entire length of object "**O**".

Referring now to **FIG. 6**, the apparatus **10** may further comprise a brush head **92**. The brush head **92** is positioned below the base **12** and mandrel **14** and is selectively movable adjacent the object "**O**". The brush head **92** engages the strip material "**S**" applied to the object "**O**", the brush head **92** removing air pockets from the object "**O**". Brushing of the strip material "**S**" by the brush head **92** on the applied strip material "**S**" firmly presses the strip material "**S**" against the heated object "**O**" providing increased adhesion between the strip material "**S**" and object "**O**". Manufactures of various types of strip material "**S**" recommend firm pressing of the strip material "**S**" immediately after application (as embodied by the brushing

from brush head **92**) to ensure firm adhesion therebetween. The brush head **92** comprises a bristled structure coupled to a pivotal brush head arm **94** that raises and lowers the brush head **92** into the proper engaged or disengaged positions. The brush head **92** length may be reduced to focus the brushing onto the surface area to which the strip material "**S**" is specifically applied to object "**O**". When actuated during the operation sequence, the pivotal brush head arm **94** moves from a lowered (and disengaged) position to a raised (and engaged) position, the brush head **92** adjacent to the exterior circumference or perimeter of object "**O**". The brush head **92** is actuated to engage the exterior circumference or surface of object "**O**" for approximately one revolution of object "**O**". Thereafter, the sequence deactivates the brush head **92**, wherein the brush head arm **94** retracts and returns to the home or starting position away from the object "**O**". The brush head **92** is dimensioned so as to provide coverage along the entire length of object "**O**".

As depicted in **FIG. 1**, the apparatus **10** may further comprise a visual detector / curtain **96**, in conjunction with full perimeter guarding where access is not required, wherein a pair of detectors **96a** and **96b** are affixed at a front of the apparatus **10**, wherein unauthorized penetration of an item (such as an operator's arm, leg, a tool or other flying debris) breaks a beam between the detectors **96a** and **96b** and automatically terminates the application cycle. This automatic termination prevents injury to an operator, damage to tools, damage to the apparatus **10**, and ensures the safe operation of the apparatus **10** in general.

Object "**O**" is envisioned as encompassing a variety of shapes, forms and dimensions. Among the objects envisioned are drums, barrels, cones (providing they have steps to reduce the draft at the strip material location), cylinders and other similarly shaped vessels, and also includes non-cylindrical items, such as polygonal bodies. Of particular interest, although not a limitation to the scope and spirit of the invention, are traffic control devices, including highway drums and sand-filled safety barrels.

Strip material "**S**" is envisioned as encompassing reflective tape, packaging tape, deformable metal material (for application on a wooden barrel or keg, for instance), deformable rubber material, or other similarly envisioned and interchangeable items.

The apparatus **10** is depicted in **FIG. 1** as supported by and enclosed within a frame. However, the apparatus **10** is capable of installation and operation outside the confines of the frame depicted. For instance, the base **12** and the components thereof are envisioned as freely standing alone, the applicator assembly(ies) **18** are envisioned as free standing, and the flame member **82** and brush head **92** are envisioned as mountable above and below, respectively. Other combinations are further envisioned without departing from the scope and spirit of the invention.

It is envisioned that other styles and configurations of the present invention can be easily incorporated into the teachings of the present invention, and only one particular configuration shall be shown and described for purposes of clarity and

disclosure and not by way of limitation of scope.

2. Operation of the Preferred Embodiment

The apparatus **10** is intended to apply strip material "**S**" to an object "**O**" in a manner in agreement with the description of the apparatus **10** described above. The aforementioned methods of applying strip material "**S**" may be categorized as having an initial sequence, an intermediate sequence, and a terminal sequence.

The initial sequence includes seating of the object "**O**" onto the mandrel **14**, actuating engagement of the plurality of clamps **16** onto the object "**O**" and actuating rotation of the mandrel **14**. The initial sequence may further comprise the steps of moving the direct flame plasma treatment member **82** adjacent to object "**O**", flaming an exterior surface of object "**O**" to evaporate liquid residue, and moving the direct flame plasma treatment member **82** away from object "**O**".

The intermediate sequence includes urging of at least one strip material applicator assembly **18** forward to engage and apply strip material "**S**" to object "**O**" and then severing the strip material "**S**" after object "**O**" completes one revolution about the base **12**. The intermediate sequence may further comprise moving a brush head **92** to engage the strip material "**S**" as applied to object "**O**", dispersing of air pockets and aiding adhesion between the strip material "**S**" and object "**O**" by engagement of the brush head **92** with object "**O**", and moving the brush head **92** away from object "**O**".

The terminal sequence includes terminating rotation of the mandrel **14** and seated object "**O**", releasing engagement of the plurality of clamps **16** from object "**O**", and removing object "**O**" from the mandrel **14**.

A first envisioned method for applying strip material "**S**" to an object "**O**" comprises the steps of:

(a) securing or seating an object "**O**" to the rotating mandrel **14**;

(b) actuating engagement of a plurality of clamps **16** onto object "**O**";

(c) rotating the mandrel **14** and object "**O**";

(d) urging at least one strip material applicator assembly **18** forward to engage and apply strip material "**S**" to object "**O**";

(e) severing the strip material "**S**" after object "**O**" completes one revolution;

(f) terminating rotation of the mandrel **14** and object "**O**";

(g) releasing engagement of the plurality of clamps **16** from object "**O**"; and

(h) removing object "**O**" from the mandrel **14**.

A second envisioned method for applying strip material "**S**" to an object "**O**" comprises the steps of:

(a) securing or seating an object "**O**" to the rotating mandrel **14**;

(b) actuating engagement of a plurality of clamps **16** onto object "**O**";

(c) rotating the mandrel **14** and object "**O**";

(d) moving the direct flame plasma treatment member **82** adjacent to object "**O**";

(e) flaming an exterior surface of object "**O**" to evaporate liquid residue;

(f) moving the direct flame plasma treatment member **82** away from object "**O**";

(g) urging at least one strip material applicator assembly **18** forward to engage and apply strip material "**S**" to object "**O**";

(h) severing said strip material after object "**O**" completes one revolution;

(i) moving a brush head **92** to engage the strip material "**S**" as applied to object "**O**";

(j) dispersing air pockets and aiding adhesion between the strip material "**S**" and object "**O**" by engagement of the brush head **92** with object "**O**";

(k) moving the brush head **92** away from object "**O**";

(l) terminating rotation of the mandrel **14** and object "**O**";

(m) releasing engagement of the plurality of clamps **16** from object "**O**"; and

(n) removing object "**O**" from the mandrel **14**.

Other envisioned methods are contemplated, including the removal of steps

(d) through (f) in the second envisioned method above (constituting a fourth method), and also including the removal of steps (i) through (k) in the second envisioned method (constituting a fourth method).

As depicted in the figures, the object "**O**" is specifically shown as a traffic control device, such as a drum or barrel manufactured to the governmental standards set forth in the MUTCD (noted in the background portion). "**S**" is strip material, depicted as reflective sheeting or tape applied to traffic control devices in accordance to the standards set forth in the MUTCD. It should be noted that the use of traffic control devices and corresponding reflective material in this application is for purposes of illustration, and should be interpreted as a limitation on the scope of the claims disclosed below.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the Claims appended hereto and their

equivalents. Therefore, the scope of the invention is to be limited only by the following claims.